



NASA SBIR 2017 Phase I Solicitation

H7.02 In-Space Manufacturing of Precision Parts

Lead Center: MSFC

Participating Center(s): GRC, LaRC

Technology Area: TA12 Materials, Structures, Mechanical Systems and Manufacturing

Currently, both 3D Printers onboard the International Space Station (ISS) use Fused Deposition Modeling (FDM), an additive manufacturing extrusion based process that builds up a plastic part layer by layer. Since this process is not dependent on buoyancy driven convection to achieve material consolidation, it is highly functional in the microgravity environment and no microgravity effects on material outcomes have been observed to date. To expand material capabilities and impart an ability to produce high-strength, precision components on-orbit, candidate metal manufacturing technologies are currently being investigated for adaptation to microgravity.

This part of the subtopic seeks to develop concepts for innovative manufacturing technologies for on-demand production of precision parts in the microgravity environment. For example, an innovative manufacturing solution could be a hybrid system that consists of an additive manufacturing process that can produce near-net shape parts and a traditional subtractive process that finishes the parts to the desired net shape. The quality of fabricated parts (dimensional accuracy, surface finish, etc.) should be comparable to what is achievable by a commercial off the shelf CNC machine.

This subtopic seeks innovative technologies in the following areas for in-space use:

- Innovative on-demand manufacturing technologies and techniques adaptable for use in the microgravity environment (such as hybrid additive and subtractive systems or other novel manufacturing techniques).
- Systems that address microgravity considerations such as debris / cutting fluid management and control of feedstock are of special interest.
- Preferred feedstock materials are aerospace metal alloys, however other materials such as high strength polymers, composites, and ceramics are also of interest.
- Easily scalable manufacturing technologies that can function using minimal power, mass, and volume due to operational constraints on space missions.

Phase I Deliverables - Feasibility study with proposed path forward to develop a full scale engineering unit in Phase II. Study should address operational constraints for system deployment on ISS such as system mass, volume, and power, as well as initial safety considerations such as material flammability, toxicity, and handling. It is desirable to have a bench top proof-of-concept/laboratory demonstration, including samples and test data, proving the proposed approach to develop an engineering unit in Phase II (TRL 3-5).

Phase II Deliverables - Functional Engineering Unit of proposed product. Full report of development and test data, including relevant material test data for samples produced by the Engineering Unit (TRL 5-6). Report should also

address how the design will meet flight certification and safety requirements

Phase III Deliverables - Flight Unit for International Space Station Technology Demonstration Payload. Phase III deliverable includes all supporting documentation for flight certification, safety requirements, and operations.